Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

January 15, 2001
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File No.: G26
10CFR50.73
STI: 31218843

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

South Texas Project
Unit 1
Docket No. STN 50-498
Licensee Event Report 00-007
Manual Unit Trip with Safety Injection

Pursuant to 10CFR50.73, South Texas Project submits the attached Unit 1 Licensee Event Report 00-007 regarding a manual unit trip with safety injection. This event did not have an adverse effect on the health and safety of the public.

Licensee commitments are listed in the Corrective Action section of the attachment. If there are any questions on this submittal, please contact either Mr. S. M. Head at (361) 972-7136 or me at (361) 972-7800.

G L Parkey

G. L. Parkey
Plant General Manager

kjt

Attachment: LER 00-007 (South Texas, Unit 1)

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U. S. Nuclear Regulatory Commission
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NRC FORM 366 (6-1998)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104	EXPIRES 06/30/2001

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4)

Manual unit trip with safety injection

EVENT DATE (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAME	DOCKET NUMBER
										05000
12	16	2000	2000	0 0 7	00	01	15	2001	FACILITY NAME	DOCKET NUMBER 05000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

OPERATING MODE (9)	1		20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)	50.73(a)(2)(viii)
POWER LEVEL (10)	100%		20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)	50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)	73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)	X	50.73(a)(2)(iv)	OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Scott Head - Manager, Licensing	(361) 972-7136

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	TA	GATE	W120	Y					
X	AB	CNV	F130	Y					

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	x	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On December 16, 2001 at 2300, a manual reactor trip was initiated when all main turbine governor valves closed during preparations to perform the monthly main turbine valve testing surveillance. During the ensuing transient an automatic safety injection occurred due to lowering reactor coolant system pressure resulting from a pressurizer spray valve control anomaly. Plant pressure decrease was terminated when partially open pressurizer spray valves shut and auxiliary feedwater flow was throttled. The highest reactor coolant pressure achieved during this transient was 2310 psig which is 75 psig above the normal operating value. Adequate subcooling was maintained and the reactor head area remained full during the transient. Maximum pressurizer level during the transient was approximately 63.8% which is below the high level alarm setpoint. Reactor coolant system pressure reached a minimum of 1480 psig during the transient due to partially open pressurizer spray valves. The cause of the main turbine governor valves shutting was a failure a logic card in the analog electro-hydraulic controller. The cause of the pressurizer spray valves anomaly was a calibration shift of the spray valve I/P converters. Corrective actions included replacement of the gate logic card, calibration of spray valve I/P converters, and planned replacement of the pressurizer spray valve I/P converters with an improved model.

TEXT *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

DESCRIPTION OF EVENT

On December 16, 2001 at 2300, a manual reactor trip was initiated when all main turbine governor valves closed during preparations to perform the monthly main turbine valve testing surveillance. During the ensuing transient an automatic safety injection occurred due to lowering reactor coolant system pressure.

As part of the setup for the main turbine valve surveillance testing, preparations were being made to reduce power to 98%. Three sets of pressurizer backup heaters were energized to avoid approaching departure from nucleate boiling pressure limits during valve stroking. Pressurizer heater operation caused the spray valves to have a constant demand signal. Turbine control was transferred to the impulse pressure feedback "in" mode as part of the surveillance. After the transfer, it was noted that this mode of control did not respond as expected. Turbine control was returned to the impulse pressure feedback "out" mode.

Upon return of turbine control to the impulse pressure feedback "out" mode, all four turbine governor valves traveled shut over the next 12 seconds. With a load rejection in progress, a manual reactor trip was initiated. Pressurizer spray valves opened as expected in response to the initial increase in reactor coolant temperature and pressure due to the load rejection. Increased temperature in the pressure relief tank and in the power-operated relief valve (PORV) tailpipe indicated a momentary lift of one pressurizer PORV.

The appropriate emergency operating procedure was entered. After the reactor was tripped, reactor coolant pressure began to drop due to primary plant cool down and pressurizer spray flow. Indications were checked to determine if safety injection had occurred or was required. It was determined that indications were within expected bands for a reactor trip. Eighty-two seconds following the manual reactor trip, an automatic safety injection actuated at the low pressurizer pressure setpoint. The auxiliary feedwater system actuated due to the safety injection signal and started feeding the steam generators at maximum rate.

After reactor coolant system pressure had lowered below the spray valve close setpoint, the spray valves were observed to still have open indication with a signal that was slightly above zero demand. The spray valve controllers were placed in manual to shut the valves. The spray valves physically shut when instrument air was removed from the actuator as a result of the containment isolation valves closing upon receipt of the safety injection signal. After taking manual control of the auxiliary feedwater system and throttling back flows as allowed per the emergency operating procedure, reactor coolant system pressure reached a minimum of 1480 psig and then began increasing. During this transient, approximately 2200 gallons of safety injection water entered the reactor coolant system.

The highest reactor coolant pressure achieved during this transient was 2310 psig which is 75 psig above the normal value. Adequate subcooling was maintained and the reactor head area remained full during the transient. Maximum pressurizer level during the transient was 63.8%, which is below the high-level alarm setpoint. Following termination of the transient, reactor coolant temperature did not return to the expected value. Three of 12 steam dump valves were found approximately 10% open. These valves were manually isolated.

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

DESCRIPTION OF EVENT (CONTINUED):

The calibration of the pressurizer spray valve I/P converters were checked. The I/P converter for spray valve 0655C had a 15% output signal when spray valve demand was 0%. The I/P converter for spray valve 0655B had a 5% output signal with a demand of 0%. A review of industry operating history for the Fisher 546 model I/P converter used to control the pressurizer spray valve indicated occurrences of calibration drift over an entire operating cycle. At the South Texas Project, calibration drift has been indicated by partially open spray valves (position indication of 5% open), higher-than-design spray line temperatures and excessive pressurizer control bank heater usage as indicated by pressurizer master pressure controller output. This mode of failure can be identified before a 15% calibration drift is experienced. These indications of calibration drift were not observed for the affected pressurizer spray valves. For this event, the data observed indicated that a sudden shift in calibration occurred when the I/P converter rapidly cycled from a 25% open demand to a 100% open demand followed by a 0% demand signal. This sudden shift mode of failure cannot be predicted by observation of plant parameters or periodic calibration. Actions have been taken to identify a replacement converter with improved performance under existing environmental conditions.

CAUSE OF EVENT

The root cause for main turbine governor valves failing closed was a failure of gate logic card 1A05A2 for the analog electro-hydraulic controller lamp driver card. This card failure prevented complete transfer to the impulse pressure feedback "in" mode and caused the reference counter to go to zero. The reference counter being at zero caused all four valves to close when turbine control was returned to the impulse pressure feedback "out" mode.

The root cause for automatic safety injection was partially open pressurizer spray valves. A calibration shift of the spray valve I/P converters during the transient caused these valves to be driven partially open with zero (closed) demand position. This condition resulted in a larger than expected pressure drop.

ANALYSIS OF EVENT:

A notification was made to the Nuclear Regulatory Commission on December 16, 2000 at 2358 pursuant to 10CFR50.72(b)(1)(iv)(B) and 10CFR50.72(b)(2)(ii).

Unit 1 steam generators were replaced with the Δ94 model during the last refueling outage. The initial 10 seconds of the post-trip reactor coolant system response for this event was consistent with the post trip reactor coolant system pressure responses in the Model Δ94 steam generators and Model E steam generators turbine trip analyses. Updated Final Safety Analysis Report (UFSAR) Figures 15.2-2a and 15.2-2b depict the Δ94 and Model E reactor coolant system pressure and pressurizer water volume responses for the turbine trip accident with operation of the pressurizer spray valves and PORVs (minimum DNBR analysis). In both the accident analysis results and the plant data for this event, rapid post-trip reductions in reactor coolant system pressure to approximately 2150 psia occurred.

TEXT *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

ANALYSIS OF EVENT (CONTINUED):

Following the drop to 2150 psia, both of the analyses and the observed plant data exhibit a slower rate of pressure reduction. In the accident analyses, pressurizer spray is modeled to terminate within 5 seconds of the reactor coolant system pressure falling below the high pressurizer pressure deviation setpoint (@25 psi above the nominal reactor coolant system pressure of 2250 psia). In the accident analyses, reactor coolant system pressure stabilizes soon after spray valve closure as pressurizer level stabilizes, as shown in UFSAR Figures 15.2-2a and 15.2-2b.

For both the Model E and Δ94 analyses, pressurizer pressure stabilizes at a level above the safety injection setpoint. In addition, UFSAR Figures 15.2-2a and 15.2-2b reveal the pressurizer pressure responses for both Model E and Δ94 S/G designs are approximately the same. However, the actual plant data for this event revealed that pressurizer pressure continued to decrease after pressurizer water level stabilized. Given these input conditions, only two conditions could produce a decrease in pressurizer pressure:

1) Flow through pressurizer PORVs or safety valves
2) Flow through pressurizer spray valves

A review of plant data reveals that a pressurizer PORV momentarily opened and then reseated before the unanticipated depressurization. No indication of a pressurizer safety valve lift was produced. Therefore, the only mechanism to reduce pressurizer pressure was flow through pressurizer spray valves.

The impact of the steam dumps not fully closing was also evaluated. Steam release through the steam dumps will cool the reactor coolant system fluid. The reactor coolant system fluid becomes denser which could result in a decrease in pressurizer water volume. A reduction in pressurizer water volume could result in a decrease in pressurizer pressure and result in a low pressurizer pressure safety injection signal. However, plant data indicated that the actual pressurizer level was not decreasing at the time of the low pressurizer pressure safety injection signal. The pressurizer water level was comparatively steady because charging flow offset the impact of the partially open steam dump valves. Therefore, the three partially open steam dump valves was not the cause of the safety injection actuation.

Operator actions helped to mitigate the consequences of this event. Performance of the manual reactor trip reduced the RCS pressure escalation. This minimized the amount of PORV lift and subsequently prevented a greater pressure decrease than was observed during this event. Throttling of auxiliary feedwater flow limited the minimum reactor coolant system temperature and pressure which in turn allowed for a more rapid return to stable system conditions. The human performance elements associated with this event will be evaluated and lessons learned incorporated where appropriate.

The conditional core damage probability for an Inadvertent Safety Injection was determined to be 6.9E-07 using the current South Texas Project PRA model, STP_1997. Inadvertent Safety Injection was chosen for analysis

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ANALYSIS OF EVENT (CONTINUED):

because this initiating event most closely resembles the actual plant event. Inadvertent Safety Injection implies no need for the emergency core cooling system injection to make up for inventory loss, which is necessary for loss of coolant events. The Probabilistic Risk Assessment challenge in an Inadvertent Safety Injection is primarily an overcooling of the reactor vessel. In order to more closely model the loss of load event that occurred, the pressurizer PORV was assumed to open.

There were no personnel injuries, radiation exposures, offsite radiological releases, or damage to important safety equipment. All safety systems, when actuated, operated as designed with the exception of one source range nuclear instrument that did not provide proper indication. This condition was corrected on December 17, 2000.

CORRECTIVE ACTIONS

The following corrective actions have been or will be taken:

1. The gate logic card 1A05A2 for the analog electro-hydraulic controller lamp driver card in the turbine control system was replaced and tested satisfactorily.

2. The pressurizer spray valve I/P converters were calibrated.

3. A laboratory failure analysis of the gate logic card will be performed and an evaluation of the findings will be performed by June 1, 2001 to determine if additional follow-up actions are required.

4. The pressurizer spray valve I/P converters will be replaced with an improved model during the spring 2001 Unit 2 refueling outage and during the fall 2001 Unit 1 refueling outage.

TEXT *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

ADDITIONAL INFORMATION:

The following is a time line of the transient for this event.

Time	Event	Tavg (°F)	Pzr. Level (%)	Press. (psig)	Sub cool (°F)
Pre-event	Three banks of backup heaters in service, spray demand 25%	589	56.6	2242	27.7
22:59:03	Governor valves start to go shut	589	56.6	2242	
22:59:09	Primary temperature first affected, spray demand 99%				
22:59:13	Manual reactor trip	590	60.4	2290	28.3
22:59:14	Main Turbine throttle valves shut, Pressurizer PORV demand signal initiated				
22:59:15	Pressurizer pressure peaks, Turbine governor valves completely shut			2310	
22:59:19	Spray demand 0%, Pressurizer PORV demand signal terminated	591	62.8	2288	30
22:59:20	All backup heaters on				
22:59:41	Steam dumps shut	567	40.7	1992	
23:00:00	(Current plant status)	564.5	35.9	1936	64
23:00:35	SI actuation/SG feed pumps trip/two banks of backup heaters off	563		1874	61
23:01:20	AFW start	563	37.0	1818	57
23:03	Operators close spray valves with manual control				
23:04	SI flow injected into RCS	556.5	34.0	1594	45
23:05	AFW flow throttled back	554.6 (lowest value 553)	32.9	1480.6	41 (lowest value 39.2)
23:10	SI flow to the RCS is stopped	555	44.4	1557	45
23:20	SI reset				
23:45	Transitioned from 0P0P05-EO-EO00 to 0P0P05-EO-ES11				
23:48	SI Pumps secured				
NOTE:	MSIVs remained open during the event				

TEXT *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

ADDITIONAL INFORMATION (CONTINUED):

An industry events evaluation for failed pressurizer spray valve failures and safety injection events was conducted. Operating and Maintenance Reminder (O&MR) 419, issued in 1996, discussed improving the reliability of Fisher Model 546 I/P converters. This O&MR was reviewed in 1996 by the South Texas Project. It was evaluated that potential failures of this converter in the pressurizer spray valve application would generate alarms and system parameter changes that would initiate Annunciator Response Procedures and off-Normal Operating Procedure entries to respond to the plant condition. Several entries in the Institute of Nuclear Power Operations Equipment Performance Index Exchange database for Fisher Model 546 I/P converters used in spray valve applications were found. These entries span the time interval from 1984 to 1996 and all of the entries indicate that the failures did not have a significant effect on plant operation. Virtually all of the entries are for long-term drift of the I/P converter. Two previous failures were noted at the South Texas Project unit one. One occurrence was in 1990 when both spray valve I/P converters were found out of calibration. The other occurrence was in 1996 when one spray valve I/P converter was found with a 10% output and a zero demand. This converter was replaced. A review of the Institute of Nuclear Power Operations database did not produce any failures of the turbine governor system gate logic card 1A05A2 for the analog electro-hydraulic controller lamp driver card.

Generic issues associated with air-operated valves at the South Texas Project have previously been identified. The same model, Fisher 546, I/P converter used in the pressurizer spray valve application is used in other primary system critical applications. Consequently these I/P converter applications which have been risk-ranked as high or medium by the Graded Quality Assurance program are planned to be inspected and evaluated for modifications to preclude failure. The steam dump valve controllers have experienced calibration drift. Plans are in place to replace all steam dump valve I/P converters with an improved model. A South Texas Project task team was been formed to improve the integrated knowledge of air-operated valve controls and their effect on overall plant reliability. Air-operated valves have been added to the South Texas Project Top Equipment Issues List in order to provide increased management attention to these issues. In addition, South Texas Project is developing an air-operated valve diagnostic trending program.

The actuator hand wheel for three steam dump valves found approximately 10% open was cocked on the hand wheel screw. The absence of the retaining ring located between the top of the hand wheel and its retaining screw made it possible for the handwheel to move to the point that it was cocked. This condition was corrected. In addition, the other steam dump valves in both units were inspected and noted discrepancies were corrected. A design change package is being planned to remove the hand wheels from the main steam dump valve actuators to improve valve reliability.

The South Texas Project Unit 2 Licensee Event Report 91-010 reported an event regarding an automatic reactor trip and safety injection actuation due to low pressurizer pressure. In that event, the low pressurizer pressure was caused by a disengagement of the feedback arm linkage to the valve stem connecting plate on the pressurizer spray valve controller. The transient was terminated by securing three reactor coolant pumps. The cause and issues from this 1991 event were determined to be dissimilar from the December 2000 event discussed in this report.